

NEW FOSSIL FRESH-WATER MOLLUSKS FROM ECUADOR

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Specimens of fossil fresh-water mollusks recently received from Dr. George Sheppard, Geologo del Estado, Republica del Ecuador, yield three new genera, each represented by one new species, and a new species of *Pomacea*. They were collected by Doctor Sheppard in the vicinity of the towns of Biblian and Paccha, Ecuador. Until recently both these towns were in the Province of Canar, in southern Ecuador. A recent change in provincial boundaries leaves Biblian in Canar but places Paccha in the adjoining province, Azuay. The junior author has supplied the following data referring to the two localities, which lie on the watershed between the Atlantic and the Pacific:

Biblian lies a few miles northeast of the provincial capital, Azogues, and a little southeast of the city of Canar. It is located on the northwest bank of a small river, tributary of the Rio Paute, the waters of which, by way of the Rio Santiago and the Rio Maranon, reach the Amazon in western Brazil. About 7 or 8 miles north, and coming from some distance east, is a tributary of the Rio Canar, which flows into the Rio Naranjal of the Pacific drainage. Between the Naranjal and the Paute is a range of mountains, approximately 12,140 feet in altitude. Azogues, but a mile or two downstream from Biblian, has an altitude of about 8,200 feet, indicating a rapidly descending river, probably with high banks.

Paccha, now in the Province of Azuay, is a much smaller town, considerably south of Biblian and lying between the Rio Paute and a tributary, the Rio Quingeo. It is situated in a high valley, surrounded by hills, except on the side toward the Rio Paute, which here flows in an east-northeast direction. Southwest, toward the Rio Quingeo, is a high pass, but most of the surrounding country is less than 10,830 feet in altitude. Cuenca, on the Rio Matadero, a western

tributary of the Rio Paute, is the nearest large town, about 4 or 5 miles to the west. The Rio Matadero rises in the Cajas lakes, on the divide, probably the extreme western reach of the Atlantic drainage system in southern Ecuador, and perhaps in all South America. These are the nearest lakes of the Atlantic system, and consist of a number of large bodies of water in lofty valleys in the passes of Cajas. To the southwest are many small rivers, tributaries of the larger coastal rivers of the Pacific drainage.¹

At present there are no reliable data to establish the age of the deposits, but as none of the species and none of the genera except *Pomacea* occur in the recent fauna, it is probable that the age can not be later than Pliocene, and it may be earlier.

The formation is exclusively of fresh-water origin, as all the species found require a fresh-water habitat. In a former paper the senior author (Marshall, 1928) described and discussed several new genera and species of pearly fresh-water mussels from Pebas, Peru. Other authors had already described from that formation various land, fresh-water, and brackish-water shells, and a few which are doubtfully classed as marine. The land shells must, of course, have been washed in from the countryside.

Pebas is about 325 feet above sea level. Biblian is at least 8,000 feet above the sea and by air-line is only about 450 nautical miles from Pebas, although by the tortuous rivers it may be twice that far. The occurrence of fresh-water, brackish-water, and marine (?) species at Pebas suggests the possibility that formerly the locality was occupied by an estuary in which the brackish-water and marine species found a natural habitat. The inner reaches of the estuary may have been suitable for fresh-water species, just as is the case with the Rio de la Plata, in which very fine specimens of fresh-water mussels are found living, especially along the shores of Colonia. It is possible also that the species were washed down from fresh waters of higher levels. Investigation of the region between Pebas and Biblian may yield other fresh-water deposits, which will explain the mixed fossil molluscan fauna found at Pebas. As the fossil fresh-water species found at Biblian and Pebas seem to be of the same geologic age and as the two localities lie on the same stream, it appears likely that there is an intimate geological relationship existing between the two places. The presence of *Pomacea* in the deposit at Biblian may indicate a quiet-water habitat, as the recent species of the genus delight in placid waters.

¹Most of the above notes were obtained from charts and relief models owned by the Pan American Union. An instructive map of the watershed of Ecuador was published recently by Edward W. Berry (1929, p. 80).

The material filling the shells and molds of the fresh-water mussels and the mold of *Pomacea* (*Ampullaria*) is a light-gray calcareous sandstone. The surface of these specimens is yellowish brown, owing to a ferruginous-clay stain. The matrix of the *Sheppardiconcha* and the *Potamolithoides* is the same calcareous sandstone mentioned above, but the surface is grayish white, with little of the ferruginous stain. The grayish sandstone in the single valves of the mussels contains fossils and imprints of the shells of *Sheppardiconcha*, which, when they occur thus, are lightly coated with the ferruginous stain.

SHEPPARDICONCHA, new genus

Fresh-water gastropod mollusks with turritelliform spire, roundish aperture, which apparently is somewhat produced at the columellar side.

Type species.—*Sheppardiconcha bibliana*, new species, described in this paper.

Remarks.—This genus differs from *Hemisinus* Swainson in the turritellalike spire and in the rounded aperture. In *Hemisinus* the aperture is elongate and has a distinct anterior canal, making some of the species, notably the type, *Hemisinus lineolatus* Wood, resemble a very elongate *Planaxis*. *Hemisinus tuberculiferus* Conrad is not a *Hemisinus*, but belongs in *Sheppardiconcha*. *Hemisinus steeri* Conrad is apparently properly placed in the genus *Hemisinus*.

SHEPPARDICONCHA BIBLIANA, new species

PLATE 1, FIGURE 6

Shell turritelliform, imperforate, whorls numerous, slowly increasing in size, somewhat flattened. Longitudinal sculpture consisting of sinuous, slightly protractive incremental striae. Spiral sculpture of five strong, obscurely nodulous lirae on the surface of the whorls of the spire and one sunk in the suture. The upper lira and the one just above the suture a little stronger than the others and forming between them a deep channel marking the suture. Base worn but showing the remains of several lirae. Aperture roundish, columella curving forward.

Type.—U.S.N.M. No. 372837 measures: Length (upper whorls missing), 20 mm; diameter, 8.5 mm. It and a number of paratypes (U.S.N.M. No. 372838) come from Biblian, Province of Canar, Ecuador. U.S.N.M. No. 372839 includes a large number of specimens from Paccha, Province of Azuay.

Remarks.—The striking features of this species are the turritella-like form, the deeply channeled sutures, and the spiral lirae. It is related to "*Hemisinus*" *tuberculiferus* Conrad, of the Pebas group

in the Upper Amazon region of Peru, and that species also probably belongs in *Sheppardiconcha*. The species attains a much larger size than that of the type. A fragment consisting of little more than a single whorl has a diameter of 13 mm.

POTAMOLITHOIDES, new genus

Shell small, resembling *Potamolithus* but with spire depressed and base widely umbilicate or deeply excavate.

Type species.—*Potamolithoides biblianus*, new species, described in this paper.

POTAMOLITHOIDES BIBLIANUS, new species

PLATE 1, FIGURES 1-3

Shell small, somewhat beehive form. Apical whorls depressed, planorbiform, the embryonic whorl slightly sunken. Whorls rapidly increasing, flattish on the upper surface, body whorl large, subangular at the periphery, sutures linear. Base flat, widely umbilicate (or deeply excavate). Aperture oblique, outer lip thin, basal lip sinuate. Parietal wall with a thick, upstanding callus which makes the peritreme continuous.

Type.—U.S.N.M. No. 372840 measures: Height, 3.5 mm; greater diameter, 5 mm. It and many paratypes (U.S.N.M. No. 372841) come from Biblian, Province of Canar, Ecuador. The largest paratype measures: Height, 5 mm; greater diameter, 7 mm.

Remarks.—This is a fresh-water mollusk. Among recent shells its nearest relative seems to be *Potamolithus*, of which many species occur in the La Plata drainage, Uruguay, and southeastern Brazil. It may belong in the family Amnicolidae.

Genus POMACEA Perry

POMACEA BIBLIANA, new species

PLATE 1, FIGURES 4, 5

A mold showing that the shell had a depressed, nearly flat spire, rapidly increasing whorls, and ample body whorl which formed two-thirds of the whole shell, and a wide umbilicus. (The subangular periphery in front of the aperture is probably due to the whorl having been subject to pressure.)

Type.—U.S.N.M. No. 372842 measures: Height, 20 mm; greatest diameter, 30 mm. It comes from Biblian, Province of Canar, Ecuador.

Remarks.—There is no doubt that this is a *Pomacea* (until recently better known as *Ampullaria*) and therefore of fresh-water origin. While only a mold it is deemed worthy of description, as it affords additional evidence that the formation was derived exclusively from fresh-water deposits.

ECUADOREA, new genus

Fossil pearly fresh-water mussels of the subfamily Hyrianae² with plentiful radial sculpture similar to that of *Diplodon* and still more similar to that of *Hyria*. The radial ribs are arranged in a V pattern, each V nesting in a succeeding one. Posterior dorsal area with several plicae crossing it obliquely to the margin.

Type species.—*Ecuadorea bibliana*, new species, described in this paper.

Remarks.—It is difficult to decide the relationships of this genus to recent genera. Like *Prodiplodon* Marshall, from which it differs mainly in the flutings on the posterior dorsal area, it stands midway between *Hyria* Lamarek and *Diplodon* Spix. Its sculpture is more like that of *Hyria*, but it lacks the anterior clawlike projection, the symphynote posterior wing, and the very oblique appearance caused by the anterior end being very narrow while the posterior end is very broad. Several species of *Hyria* have somewhat similar flutings on the posterior dorsal area. In form the shell is more like *Diplodon*, but that genus is not so plentifully sculptured.

ECUADOREA BIBLIANA, new species

PLATE 1, FIGURES 7, 8

Shell rather compressed, subelliptic, slightly narrower in front. Concentric sculpture of fine growth striae, with a few of the rest periods a little accentuated. Radial sculpture of a number of riblets so arranged as to form a series of V's, each nesting into the succeeding one, and with other riblets at the front and back which if continued would form additional V's. The anterior prong of each V is narrow, clear-cut, and nearly straight. The posterior prong is heavier and more irregular and curves toward the front end of the shell. At the lower end where the radial sculpture dies out the surface is somewhat pimpled. The posterior dorsal area with several (five or six) distinct cordlike flutings running across it to the margin. The dorsal and ventral margins both arcuate.

Type.—U.S.N.M. No. 372843 measures: Length, approximately 33 mm; height, 24 mm; diameter, about 11 mm. It and a paratype (U.S.N.M. No. 372844) come from Biblian, Province of Canar, Ecuador.

Remarks.—In sculpture this species closely resembles *Oastalia pazi* Hidalgo, of the Province of Imbabura, Ecuador, which, however, does not have flutings on the posterior dorsal area.

² Simpson places this subfamily in the Unionidae, while Ortmann places it in the Mutelidae. The latter will probably prove correct, but can not be accepted until the supposed *lasidium* embryo of the latter is proved a mistake. See Marshall, Proc. U. S. Nat. Mus., vol. 79, art. 23, p. 12, 1931.

Genus ANODONTITES (?) Bruguière

U.S.N.M. No. 372845 includes a number of casts from Biblical that evidently were made in pearly fresh-water mussel shells. A few of them show remains of the shell on the surface. These fragments seem to have had a rather thick prismatic layer, which leads to the belief that the species belongs to the genus *Anodontites*, as a thick prismatic layer is one of the features of that genus. In most of the specimens one valve has slipped toward the ventral margin so that its beak is beneath the beak of the other valve. This slipping likewise may indicate the genus *Anodontites*, which has no teeth of any kind to serve to hold the two valves in place. The hinges of other fresh-water mussels of the region have pseudocardinal and lateral teeth, the former serving to direct the valves when the shell is closing and both helping to hold the valves in position when closed. As the teeth in one valve interlock with those of the other, force enough to break the teeth is necessary to make the valves slip.

NOTE ON DISTRIBUTION OF RECENT NAIADES

The great majority of recent South American naiades are found in the Atlantic drainage. On the Pacific side of the Andes almost none occur north of Chile. *Diplodon atratus* (Sowerby)³ has been reported from Peru. *Castalia crosseana* Hidalgo⁴ and *Diplodon pazi* (Hidalgo)⁵ were described as coming from the Province of Imbabura, Ecuador, which lies almost wholly in the Pacific drainage, although it seems probable that some small streams in its eastern part may drain into the Atlantic. *Castalia crosseana* is unrelated to any form found in the Pacific drainage, and it is of interest that its nearest relative is *Castalia linki* (Marshall)⁶ of the River Sinu, Colombia, Caribbean drainage. *Diplodon pazi* has no relative in the Pacific drainage, but many in the Atlantic.

The beak sculpture of all naiades on the Pacific side of the Andes is much reduced, consisting of a few radial bars, which occupy a small area at the beaks. The sculpture of many genera and species in the Atlantic drainage is bold, often occupying a large area. In some specimens of *Hyria rugosissima* Sowerby, a large species, the sculpture covers nearly the whole shell.

³ *Unio atratus* Sowerby, 1839. Conchological manual, fig. 148.

⁴ *Castalia crosseana* Hidalgo, 1865. Journ. Conchyl., p. 316, pl. 14, fig. 2.

⁵ *Castalia pazi* Hidalgo, 1868. Journ. Conchyl., p. 353, pl. 13, fig. 6.

⁶ *Tetraplodon linki* Marshall, 1926. Proc. U. S. Nat. Mus., vol. 69, art. 12, p. 6, pl. 1, figs. 6, 7; pl. 3, fig. 2.

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